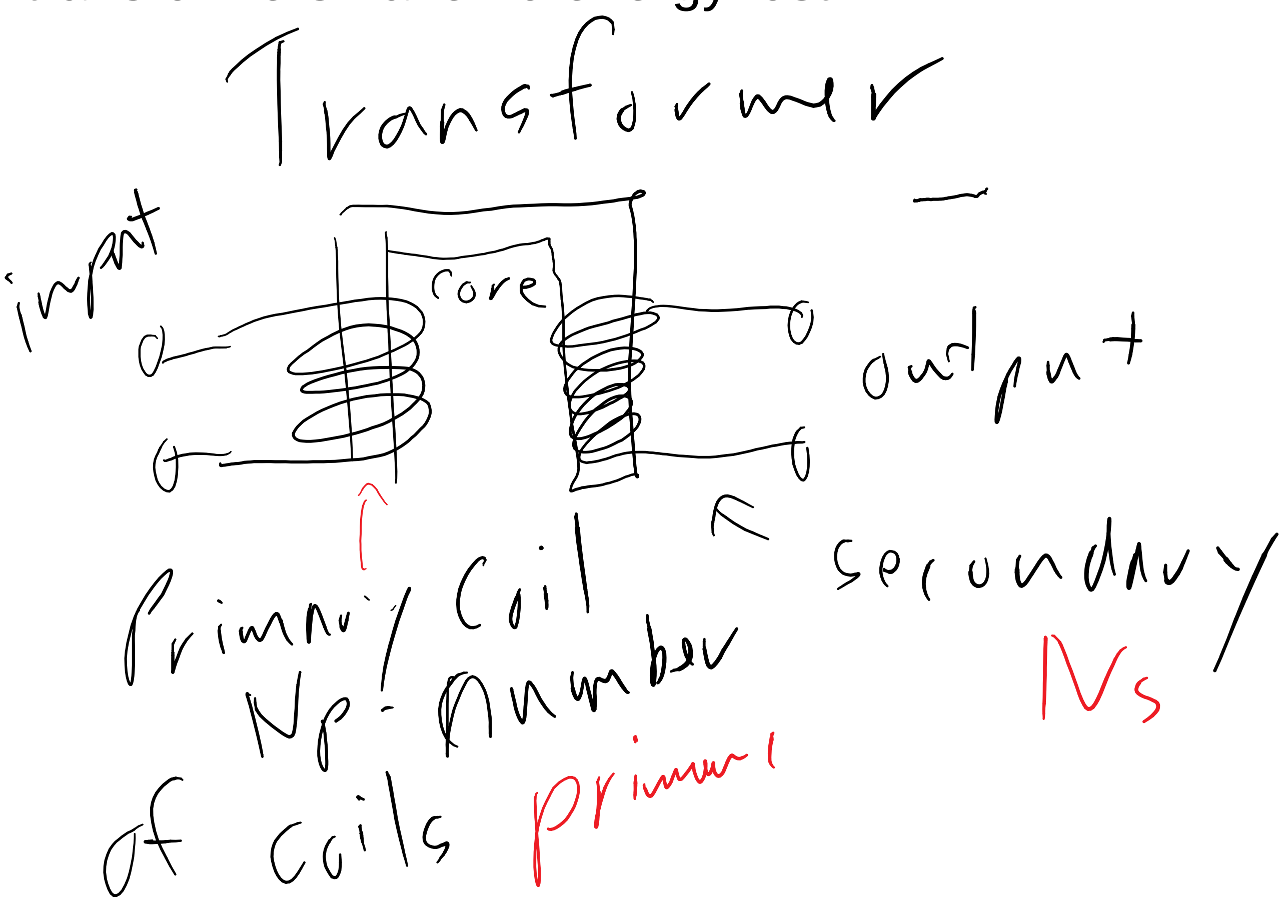
Thursday, May 19, 2016 3:30 PM

Transformers

Two sets of coils of wire with a common core. The core amplifies the magnetic field, you want to limit the energy lost as heat in the core. Ideal transformers have no energy lost.



the emf induced in the secondary is dependent on the number of coils in the secondary the strength of the magnetic field, the area, and the

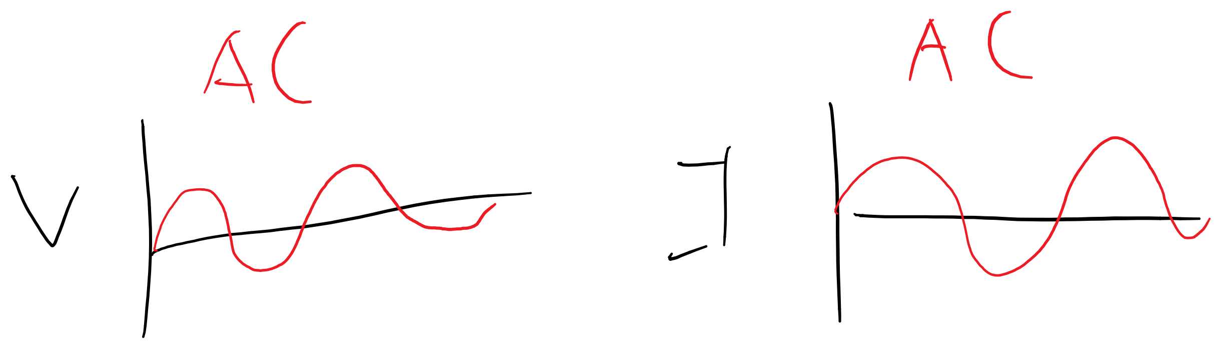
rate of change of the magnetic field.

If the magnetic field doesn't change, like for a DC input, there is not emf in the secondary.

Big Idea: Transformers only work for AC inputs.

DC is direct current - like a battery

AC is alternating current - like wall socket where the voltage and current change as a sinusoidal function.



To derive our equation, we use the law of conservation of energy, so the power into the primary is equal to the power out of the secondary in an ideal (100% efficient) transformer.

Pin = Pout for an ideal transformer

$V_p I_p = V_s I_s$
p is for primary s is for secondary
- doesn't necessarily match Ohm's law
voltage in the secondary is proportional to the number of turns in the secondary.

$V_p/V_s = I_s/I_p = N_p/N_s$

$$emf_s = -N_s \frac{\Delta\Phi}{\Delta t}$$

$$\Phi = BA$$

$$B = \mu_0 \frac{N_p}{L} I_p$$

- a step up transformer is when the voltage increases, $N_s > N_p$ $V_s > V_p$ and $I_s < I_p$

eg. a step up transformer is connected to 120V in the primary with 8 turns. The output has 250 turns and is connected to a load with output current 2.0A.

What is the voltage in the secondary and current in the primary?

What is the advantage of transferring power at high voltage?

p567 q23-31 odds

$$\frac{V_p}{V_s} = \frac{N_p}{N_s} \qquad V_s = \frac{V_p N_s}{N_p}$$

$$V_s = \frac{120V \; 250}{8}$$

$$\boxed{V_s = 3750V}$$

$$I_p = ? \qquad \frac{I_s N_s}{N_p} = I_p$$

$$\frac{2A(250)}{8} = \boxed{62.5A}$$

$$P = I^2 R$$

So the reason we use transformers is that the energy lost in transmission cables is much lower if the current is low and the voltage is high. Step down transformers at your house return the power to 120V.

Q3
0.14A

4a) 3.0V
b) 5.0A
c) 15W

5 emf = 0.0019V

6 1750rpm

V1/V2 = f1/f2

emf = change in B and A/t
f=1/t
emf = 2pi BAf
f is revolution frequency

7 V = 0.0020V

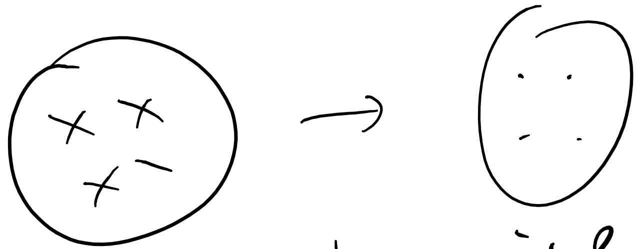
8a) F=qvB = 1.0Cx 3.0m/s x 3.0 T
=9.0N
b) 9.0N but outward
c) W=Fd = 9.0N x 0.10m = 0.90J
d) V=energy/charge = 0.90J/1.0C = 0.90V
or emf = BLv = 3.0T x 0.10m x 3.0m/s

e) I=V/R = 0.90V/0.090ohms = 10A
f) F=BIL = 3T x 10A x 0.10m = 3.0N

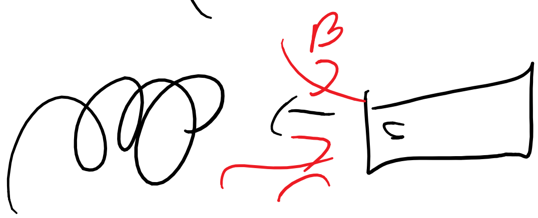
p566

Q 6

emf = bf-bi x A/t =0.85--0.25 x

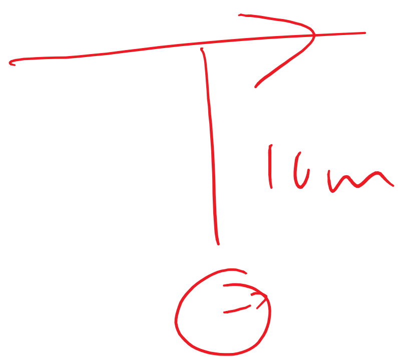


clockwise



I = 100A

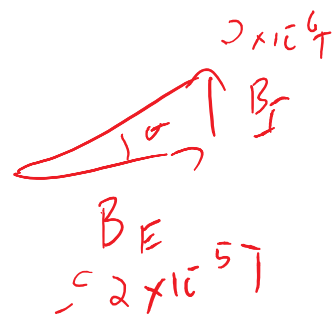
Q 1



$$B = \frac{\mu_0 I}{2\pi r} = \frac{4\pi \times 10^{-7}(100A)}{2\pi(10m)}$$

$$= 2.0 \times 10^{-6}\ T$$

10% deviation



$\tan\theta = \frac{1}{16}$

$\theta = 3.7°$ shift

Power lines are AC

so it won't matter :)

Q2

$F = BIL$

$F = \frac{\mu_0 I_1 I_2}{2\pi r_a} L$

$F_1 = 3.6 \times 10^{-3}$ N up

$F_2 = 4.0 \times 10^{-4}$ N down

$F_{net} = 3.2 \times 10^{-3}$ N up